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Comparative Analysis of Concrete Partial Rubber Replacement

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Abstract*: In this paper, the mechanical and the durability properties of concrete that partially replaced some amount of rubber have been compared. Waste tire rubber which was ground into fine aggregates replaced natural aggregates at various levels of volumes. Important properties such as water absorption, workability, tensile strength and compressive strength were determined. As per the findings, incorporation of more rubber enhances durability and impact resistance due to an increase in water permeability and fracture resistance, yet the compressive and tensile strength is reduced since rubber is not so stiff. The replacement was sensible and balanced in terms of both strength and sustainability. This study brings to the fore the possibilities of rubberized concrete as an eco-friendly construction material that serves to aid waste management alongside ensuring competency in terms of structural performance when used in non-load-bearing capacity.*

Keywords*: Shredded tire, Ground rubber, Split tire, Waste tire, Mechanical property, Durability, Crumb rubber*

I. Introduction

Strength, durability and adaptability of concrete means that it is the most widely used building material the world over. Nevertheless, cement production and extraction of natural aggregates are also very harmful to the environment. Over the past years, researchers have sought potential alternatives to be able to minimize the adverse environmental impact of concrete. One of the strategies employed is recycling of resource materials like the used tyre rubber as partial substitution of natural aggregates. Due to the lack of biodegradation of tires and the common occurrence of tires being discarded in the landfill, or even being discarded to be burned into poison-spitting machines, the rising tyre quantities warrants huge health and environmental hazards [2].

One of the possible solutions is the incorporation of rubber in the waste tires into the concrete, which will encourage sustainability and utilisation of waste. Rubberised concrete, however, possesses different mechanical and physical properties with normal concrete. This study is aimed at making a comparative analysis of reinforced concrete with partial replacements of manual aggregate with rubber with an aim of determining the possibility and efficiency of this. The research seeks to study the effects of the various rubber content level (5%, 10%, and 15%) on compressive strength, tensile strength, workability, and durability. This research research aids in the development of environmentally friendly products used in construction that favour healthy engineering methods and efficient waste disposal through the identification of an optimal combination of toughness and ecological gain.

II. Properties of Crumbed Rubber

A partial replacement of fine particles in concrete is usually done by the use of Crumbed rubber, which is made out of the recycled tires who are gathered up as scrap. It is characterized by heaviness, elasticity and coarse surface. The shape of rubber particulate is usually irregular and Rubber particles vary in size depending on the grinding procedure. Crumbed rubber is less dense, so it allows reducing the total weight of concrete mixes. It is also very tough making it pretty premium in impact absorption, and resistant to cracking [4-6].

Nevertheless, crumbed rubber has a lower modulus of elasticity and ability of cement paste bonding that may negatively affect mechanical strength of concrete. It is also of hydrophobic nature, which also determines the water absorption and mix of workability. Nonetheless, the restraints, crumbed rubber hikes durability by resisting shrinkage, assaults with chemicals, thermal cracking, which is suitable in non- structural and professional constructions.

III. Durability and Use of Crum Rubber

When the concrete is used in crumb rubber, it affects the efficiency and the durability to a great extent. Although mechanical strength of rubberised concrete generally decreases with addition of an increasing amount of rubber as a result of the ill-compressibility of rubber particles and poor admixing with cement paste, its durability properties often get better [1].

Crumb rubber used in concrete enhances impact resistance and energy absorption capacity of concrete rendering it suitable in applications where there are dynamic or vibratory loading. It also enhances resistance to freeze-thaw cycle since the rubber particles are used as spaces to hold the air, and adjust any internal strains caused by the variation in temperatures. This renders rubberised concrete to be suited to cold temperature.

The presence of rubber particles inhibits also the permeability thereby not allowing hazardous chemicals like chlorides and sulphates to penetrate. This has the ability to lengthen the durability of concrete under severe environments. Moreover, the higher resistance to crack and flexibility helps to avoid the future shrinkage and cracking of the surface. Crumb rubber concrete does well in applications that do not need support like pavements, pavements, acoustical barriers, lightweight blocks and precast sections. It can also be used where there is need to issue reduction that is created by noise or vibration like rail pads and foundation layoffs. Although of low compressive strength, crumb rubber concrete is beneficial to the environment, and economy, as it promotes recycling in addition to reducing landfill waste.

IV. Conclusion

A comparison study of concrete and partially replaced concrete with rubber crumb illustration explains the potential and drawback of rubberised concrete. An increase in rubber content causes a decrease in the compressive and tensile strength because of the bad bonding and poor stiffness, but it enhances durability on aspects like impact resistance, crack control and tolerance towards harsh weather conditions. A sustainable replacement rate of about 10% aims at maintaining a sensible balance between the lifetime of the equipment and mechanical efficiency. Rubberised concrete is most suitable in non-structural or light structural work, increasing the use of environmentally friendly building and ensuring re-use of the scrap tires and reducing the use of natural aggregates.

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